ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

PROJECT NO. 6 - VISION IN TANKS

Fifth Partial Report

On

Sub-Project No. 6-2, Characteristics and Limitations of Present Visual Devices in Tanks.

IMPROVEMENT IN DRIVER'S VISION IN TANKS

Project No. 6-2

7 September 1944

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IMPROVEMENT IN DRIVER'S VISION IN TANKS

1. PROJECT: No. 6 - Vision in Tanks; Fifth Partial Report on Sub-Project No. 6-2, Characteristics and Limitations of Present Visual Devices in Tanks.

a. Authority: Letter Commanding General, Headquarters, Armored Force, Fort Knox, Kentucky, File 400.112/6 GNOHD, dated 24 September 1942.

b. Purpose: To indicate a method for improving driver's vision in tanks.

2. DISCUSSION:

a. The standard tank driver's periscope holder will rotate vertically through an angle of $\pm$ 30° from the horizontal. Since the periscope itself has $12\frac{1}{2}$° vertical vision, (maximum limits), a total field of $72\frac{1}{2}$° is available.

b. To attain the extra 60° of vision ($\pm$ 30°), however, the periscope must be adjusted by hand as the occasion demands. To make these necessary adjustments, the driver must take one or both hands from the controls of the tank, causing the vehicle to be momentarily out of his complete control.

c. A device which makes possible the full use of available vertical rotation without requiring hand adjustment of the periscope is described in Appendix I. A description of a method of installation is given in Appendix II.

3. CONCLUSION:

a. Means for more practical utilization of available vertical field of vision through tank driver's periscope is desired.

b. The driver must be able to gain greater vision merely by head movement. He should not sacrifice vehicular control for better vision.

4. RECOMMENDATIONS:

That a spring device similar to that described in the Appendix be developed as a field fix on present vehicles to permit the driver to rotate his periscope on its axis by head pressure alone.

(NOTE: The conclusions and recommendations set forth above have been concurred in by Headquarters, Armored Center, W. H. Nutter, Colonel, G. S. C., Chief of Staff).

Submitted by:
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WILLARD MACHLE
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#1 - Appendix I
#2 - Appendix II

APPENDIX I

The difficulties of buttoned-up tank driving because of limited vision are well recognized. While a total field of $72\frac{1}{2}^{0}$ vertical vision is attainable by rotation of the periscope, only $12\frac{1}{2}^{0}$ vertical field is obtained without readjustment. Owing to this limited vertical field of vision provided through his periscope, the driver must take his hands off of the steering levers frequently to adjust the periscope as the ground slope changes. During these periods of adjustment, the tank may be momentarily out of control.

In order to eliminate this objectionable feature of buttoned-up driving, a method of spring-loading the periscope has been devised which enables the driver to obtain upward, horizontal or downward vision from his periscope simply by moving his head. This requires spring action to keep the periscope in its maximum depressed position except when head pressure is applied on a brow-pad to elevate the line of sight to the desired operating position up to the angle of maximum upward vision. As pressure is decreased, the periscope tends to return to its maximum depressed position.

Several types of springs were tried as a means of keeping the periscope in its maximum depressed position while at rest, and at the same time permitting rotation without excessive head pressure. The universal difficulty was that as the elevation of the line of sight increased, the resistance of the spring to the head movement became progressively more difficult, owing to the greater moment of the force exerted by the spring as the angle of elevation increased.

This difficulty was overcome by using a leaf-type spring so designed that the effective length of lever decreases with elevation to compensate for the increasing force exerted on the spring in compression, and thus keeping the restoring moment nearly constant throughout the entire rotation of the periscope holder (See Fig. 1).

In the proposed design, a 1/8" steel plate mounts directly on the rotor and holds the spring in place. A roller mounted on the periscope holder provides the means of flexing the spring. This roller and mounting is so designed that it forms a guide in which the spring slides. A brow-pad provides a comfortable means for the driver to apply the required head pressure to the system.

As shown in Fig. 1, the spring (C) is riveted to the mounting bracket (B) and firmly mounted to the periscope rotor. The spring makes contact with the periscope holder through a roller bearing (A) which is mounted on the side of the periscope holder, as shown at A^{1}.

The spring is compressed by the rotation of the periscope on its axis and its expansion in turn causes rotation of the periscope in the opposite direction.

Although the periscope must rotate through 60^{o}, the elastic limits of the spring must not be taxed. To insure this, a relatively long, specially shaped spring is used. It is compressed by a sliding action at its point of contact with the periscope holder, and its expansion in turn causes a sliding action in

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the opposite direction. Since any such action causes friction, a roller bearing is mounted on the periscope holder and forms the point of contact with the spring, keeping the friction to a minimum. The roller assembly is so constructed that it forms a guide for the spring.

The spring holds the periscope in its maximum downward position at rest. As pressure is exerted at the rear of the holder, the periscope rotates on its axis toward its angle of maximum elevation and the spring is gradually compressed. As the pressure is relaxed, the spring expands, forcing the periscope to rotate on its axis in the opposite direction toward its angle of maximum depression. The present design was constructed by using materials on hand. Undoubtedly, it could be improved upon by the use of better materials.

DISCUSSION-

This device has been tried by approximately 25 different tank drivers at Fort Knox, Kentucky. In these trials, the tank was operating cross-country, over rather rough terrain. There were no unfavorable reactions, and the drivers were unanimous in favoring its adoption. Three of the group stated that they noticed a slight strain in the neck muscles, but believed that as they became accustomed to the pressure, this condition would be overcome.

In the event that the driver does not wish to use this device, the friction lock that is now on the rotor will lock the periscope in any desired position. This locking feature in no way interferes with the operation of the spring return when the periscope holder is in the unlocked position.

It has been found that with a clean, well lubricated rotor, and with the aid of the spring device and brow-pad, it is sometimes possible to achieve horizontal rotation of the periscope merely by head action.

It has also been found that with the device in operation, (i.e., periscope holder not locked in any position) and the hatch open, the periscope is held in such a position that an accidental or careless slamming of the hatch will not shear off the periscope head. From unofficial estimates, the number of sheared periscope heads is reported to average one head per day per tank platoon (in the Zone of the Interior). This saving, therefore, seems to be worthwhile.

The device is suitable for adaptation to all tanks now in existence, including the armored L.V.T. and is extremely simple to apply in the field. It can be installed with the aid of a screwdriver and a wrench in less than ten minutes by following simple directions. The parts, including brow-pad, can be packed and shipped in a kit measuring 6" x 8" x 6" and weighing less than 4 pounds. Appendix II gives method of installation.

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APPENDIX II

1. Installation of Spring Device

   a. Preparation of Rotor

      (1) Open hatch

      (2) Remove 2 flat head screws in rotor. These are the 2 screws nearest the part of the rotor that is in front of the periscope holder and opposite the periscope holder lock.

   b. Assembly of Spring Device

      (1) Screw special nut into middle (top to bottom) hole of periscope holder, and tighten up nut.

      (2) Now slide spring and bracket assembly into place. The spring should now rest against the bearing assembly and be compressed so that the 2 round head bolts can be started into the rotor.

      (3) Tighten up round head bolts. Device is now ready for use.

   c. Tools required.

      1 each - screwdriver (heavy)
      1 each - 9/16" open end wrench

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